



APPLIED STATISTICS FOR AGRICULTURAL SCIENCES

D. VENKATESAN

Applied Statistics For Agricultural Sciences

D. VENKATESAN
Department of Statistics
Annamalai University
Annamalai Nagar - 608 002,
Tamil Nadu, India



NEW INDIA PUBLISHING AGENCY
New Delhi – 110 034



NEW INDIA PUBLISHING AGENCY

101, Vikas Surya Plaza, CU Block, LSC Market

Pitam Pura, New Delhi 110 034, India

Phone: + 91 (11) 27 34 17 17 Fax: + 91(11) 27 34 16 16

Email: info@nipabooks.com

Web: www.nipabooks.com

Feedback at feedbacks@nipabooks.com

© Author, 2014

ISBN : 978-93-83305-28-5

All rights reserved, no part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior written permission of the publisher or the copyright holder.

This book contains information obtained from authentic and highly regarded sources. Reasonable efforts have been made to publish reliable data and information, but the author and publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The author and publisher have attempted to trace and acknowledge the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission and acknowledgements to publish in this form have not been taken. If any copyright material has not been acknowledged please write and let us know so we may rectify it, in subsequent reprints.

Trademark notice: Presentations, logos (the way they are written/presented) in this book are under the trademarks of the publisher and hence, if copied/resembled the copier will be prosecuted under the law.

Composed and Designed by NIPA

Contents

<i>Preface</i>	<i>v</i>
1. Introduction	1
1.1 Definition of Statistics	1
1.2 Statistics as Numerical Data	1
1.3 Function of Statistics	4
1.4 Divisions of Statistics	6
1.5 Importance and Scope of Statistics	6
1.6 Collection of Data	8
1.7 The Preliminaries in Collecting Data	8
1.8 Methods of Collecting Primary Data	11
1.9 Sources of Secondary Data	18
1.10 Unpublished Source	19
1.11 Limitations of Statistics	19
2. Classification, Tabulation and Graphical Representation	21
2.1 Quantitative Classification	21
2.2 Variable	22
2.3 Array	22
2.4 Frequency Distribution	23
2.5 Cumulative Frequency Distribution	33
2.6 Diagrammatic and Graphical Representation	38
3. Measures of Central Tendency	49
3.1 Introduction	49
3.2 Definition of Measures of Central Tendency	49
3.3 Objectives of a Statistical Average	50

3.4	Various Measures of Central Tendency	51
3.5	Requisites of a Satisfactory Measure of Central Tendency	60
3.6	Comparison of Mean, Median and Mode	61
3.7	Empirical Relationship among Mean, Median and Mode	61
4.	Measures of Dispersion	67
4.1	Introduction and Measuring	67
4.2	The Characteristics for an Ideal Measure of Dispersion	69
4.3	Absolute and Relative Measures of Dispersion	69
4.4	Various Measures of Dispersion	70
4.5	Skewness	92
4.6	Kurtosis	100
5.	Probability	103
5.1	Random Experiment	103
5.2	Sample Space	104
5.3	Event	104
5.4	Mathematical or Classical Definition of Probability	104
5.5	Statistical Definition of Probability	105
5.6	Conditional Probability	112
5.7	Bayes' Probabilities	116
6.	Probability Distributions	121
6.1	Random Variable (R.V)	121
6.2	Distribution Function	122
6.3	Moments	124
6.4	Moment Generating Function (M.G.F)	126
6.5	Cumulants	128
6.6	Binomial Distribution	129
6.7	Bernoulli's Theorem	131
6.8	Relation between the Probabilities of X and (X+1) Successes in Binomial Distribution	131

6.9	Poisson Distribution	132
6.10	For Poisson Variate X, Relationship Between the Probabilities, P(X=x) And P(X = x+1)	136
6.11	Normal Distribution	137
7.	Sampling and Sampling Distribution	145
7.1	Meaning of Sampling	145
7.2	Census Method	146
7.3	Sample Method	147
7.4	Merits of the Sample Method	147
7.5	Methods of Sampling	148
7.6	Sampling and Non-sampling Errors	154
7.7	Classification of Data	154
7.8	Sampling and Its Uses	155
7.9	Definitions	156
7.10	Sampling Methods	161
7.11	Unrestricted Random Sampling	161
7.12	Estimation of Population Parameters	163
7.13	Properties of Estimates	164
7.14	Restricted Sampling	167
7.15	Systematic Sampling	172
7.16	Methods of Selection	173
7.17	Cluster Sampling	175
7.18	Multistage Sampling	178
7.19	Sampling Distribution	179
7.20	Student's t-Distribution	179
7.21	Chi-Square Distribution	182
7.22	Fisher's z-Distribution	184

8. Tests of Significance Testing Hypothesis about Population Mean	189
8.1 Statistical Hypotheses	189
8.2 Statistical Test	190
8.3 Decision Errors	191
8.4 Critical Region	191
8.5 Level of Significance	192
8.6 One and Two-Tailed Tests	192
8.7 Degrees of Freedom	193
8.8 Test Statistic	193
8.9 Steps in Testing of Hypothesis	193
8.10 Comparing Two Population Means Independent Samples with Equal Variances	196
8.11 Comparison of Two Population Means Independent Samples with Unequal Variances	197
8.12 Comparison of Two Population Means Correlated Samples ..	199
8.13 Testing the Significance of an Observed Correlation Coefficient	203
8.14 Comparison of Two Population Variances	210
9. Chi-Square and Association of Attributes	213
9.1 Expected Frequencies	213
9.2 Testing of Independence of Attributes in Contingency Table	215
9.3 Association of Attributes	218
9.4 Difference between Correlation and Association	219
9.5 Notation and Terminology	220
9.6 Consistency of Data	223
9.7 Association and Disassociation	224
9.8 Methods of Studying Association	224

9.9	Association of Three Attributes	232
9.10	Partial Association	241
10.	Correlation and Regression	245
10.1	Introduction	245
10.2	Meaning of Correlation	245
10.3	Linear and Non-linear Correlation	246
10.4	Simple, Multiple and Partial Correlation	247
10.5	Correlation and Causation	247
10.6	Usefulness of Correlation	248
10.7	Methods of Studying Correlation	248
10.8	Coefficient of Determination	264
10.9	Coefficient of Non-determination	265
10.10	Coefficient of Alienation	265
10.11	Probable Error	265
10.12	Regression Analysis	266
11.	Analysis of Variance	289
11.1	Introduction	289
11.2	One-way Classification	291
11.3	Two - way Classification	295
12.	Design of Experiments	299
12.1	Introduction	299
12.2	Basic Concepts	299
12.3	Basic Principles of Experimental Designs	300
12.4	Size and Shape of Experimental Units	302
12.5	Completely Randomized Design	303
12.6	Randomized Block Design	311
12.7	Latin Square Design	326
13.	Multiple Comparison Tests	341
13.1	Scheffe's Method for Comparing All Contrasts	341

13.2	Tukey's Test	343
13.3	The Fisher Least Significant Difference (LSD) Method	346
13.4	Duncan's Multiple Range Test (DMRT)	347
13.5	The Newman – Keuls Test	349
14.	Factorial Experiments	353
14.1	Advantages and Disadvantages of Factorial Experiments	353
14.2	Basic Concepts	354
14.3	Computation of Main Effects and Interactions	356
14.4	Layout Factorial Experiments	359
14.5	Analysis and Interpretation Factorial Experiments	360
14.6	Confounding in Factorial Experiments	368
15.	Split Plot Design	375
15.1	Advantages and Disadvantages of Split Plot Design	375
15.2	Layout and Analysis	376
15.3	Some Variations in the Split Design	383
15.4	Split-Split Plot Design	384
	References	387

APPLIED STATISTICS FOR AGRICULTURAL SCIENCES

Readership: Meant as a complete source books for those related to agricultural and veterinary statistics; from basics to applied, with methods and techniques required for the interpretation of data.

CONTENTS

- Introduction
- Classification, Tabulation and Graphical Representation
- Measures of Central Values
- Measures of Dispersion
- Probability
- Probability Distributions
- Sampling and Sampling Distributions
- Test of Significance
- Chi-Square and Association of Attributes
- Correlation and Regression
- Analysis of Variance
- Design of Experiments
- Multiple Comparison Tests
- Factorial Experiments
- Split Plot Design

The book is an introductory text, presenting some of the basic concepts and techniques of Statistical inference. It has been written primarily to suit the students and research workers in the area of agricultural sciences. An understanding of the logic and theory of statistics is essential for the students of agriculture who are expected to know the techniques of analysing data and drawing useful conclusions. It has been the intention of the authors to keep the book at a readability level appropriate for students who do not have a mathematical background. This book can serve as comprehensive reference source of statistical techniques helpful to agricultural research workers in the interpretation of data.

2014, 400 pages, figures, tables, 25cm

D.VENKATESAN is currently working as a Professor in Statistics, Annamalai University, India. He has more than 20 years of teaching experience at postgraduate level. He has published more than thirty research papers in International Journals. He has been awarded CSIR, DST visiting fellowships, TNSCST Young Scientist fellowship, UGC Visiting Associate, INSA summer fellowships and Visiting Fellowship by the University of Napoli-L'Orientale, Italy during 2009.



NEW INDIA PUBLISHING AGENCY

101, Vikas Surya Plaza, CU Block, L.S.C. Market
Pitam Pura, New Delhi-110 034, India

Tel. : +91(11) 27341717, Fax : +91(11) 27341616

E-mail : info@nipabooks.com

Web : www.nipabooks.com

ISBN 9789383305285

